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LABORATORY REARING OF LARVAL *OSTREA ANGASI* IN TASMANIA, AUSTRALIA

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SUMMARY

Larval *Ostrea angasi* released from parents in the summer 1974/75 were about 190-200 µm in shell length. The darkly pigmented larvae formed rounded umbones during growth and the relationship between shell length (l) and width (w) was described by the G.M. regression: w = 0.820 1 + 13.010. Eye-spots were common in those 270 µm long and spat began setting at about 300 µm when 12-20 days old at 17°C. Few pelagic larvae larger than 320 µm were observed. The provinicular structure was simple and similar to other *Ostrea* species.

Larval development differs from that in the closely related New Zealand mud oyster and provides further evidence to separate these species. Success rates varied between the 6 batches held in 901 culture containers but one batch yielded a significant spat catch on scallop shells which were kept in a recycling system before transfer to the sea. Circulation of the cultures with a vertical, central airlift appeared to enhance success.

INTRODUCTION

In the late 19th century the native or mud oyster, *Ostrea angasi* Sowerby provided a large dredge fishery and was farmed also in Tasmania (Sumner, 1972). With present emphasis on farming *Crassostrea gigas* in this State and with a non-existant dredge oyster fishery, the commercial importance of *O. angasi* has dwindled. This contrasts with the continuing and important dredge fishery for the closely related *O. lutaria* in southern New Zealand (Street and Crowther, 1973).

Despite its earlier commercial significance and also its wide distribution in southern Australian waters (Thomson, 1954), the biology of *O. angasi* is virtually unknown (Hodson, 1963; Sumner, 1972). My work with this species primarily aimed at a brief assessment of laboratory rearing methods being used with the commercial scallop, *Pecten meridionalis* (Dix, in prep., Dix and Sjardin, 1975). The present paper, however, is largely descriptive. It represents a contribution to the biology of *O. angasi* and descriptions of the pelagic larvae should assist future planktologists. In addition, the study confirms Hollis' (1963) belief that the Australian *O. angasi* and the New Zealand *O. lutaria* are distinct species.

MATERIAL AND METHODS

Present findings are based on six batches of larvae from five collections of adult oysters made in south-eastern Tasmania in January and February 1975 (Table 1).

TABLE 1. Source details of adult *Ostrea angasi* used for six larval cultures. Larvae were removed or swarmed from adults as indicated.

COLLECTION		LARVAE		
Date	Locality	Batch	Date	Source
6/1/75	Taroona	1	10/1/75	Swarmed
		2	11/1/75	"
7/1/75	Dover	3	9/1/75	"
8/1/75	Triabunna	4	6/2/75	Removed
23/1/75	Coningham	5	24/1/75	Swarmed
21/2/75	Tinderbox	6	24/2/75	Removed

After examining samples of shucked oysters for larvae, the remaining Taroona and Dover oysters were maintained in 5.7 l glass aquaria with aerated water filtered to 3 μm and changed daily. When water was changed 25 ml each of *Tetraselmis suecica* and *Phaeodactylum tricornutum* cultures were added. Triabunna oysters were kept in a 200 l fibreglass aquarium with running, unfiltered seawater and Coningham oysters in smaller (120 l) glass aquaria with a similar water supply. The Tinderbox oysters had been kept for three days in the lower part of a household refrigerator before larvae were removed.

Larvae swarmed by adults in aquaria were siphoned onto a 100 μm nylon sieve topped by a 280 μm sieve used to collect debris. Those larvae removed from shucked "black-sick" oysters were suspended in seawater and collected the same way.

Larval rearing procedures were modified from Walne (1966). Collected larvae were measured, counted and distributed to 90 l polyethylene rearing containers filled with 17°C water filtered through 25 μm, 10 μm and 3 μm cartridges and sterilised with ultra-violet light. Penicillin (2.7 g) and 4.5 g of Streptomycin were added to each container together with a 1000 ml mixture of *Isochrysis galbana* or *Monochrysis lutheri* and *T. suecica*. Culture water was changed and larvae fed every two days whilst antibiotics were added every four days.

Larval batches 1-3 were not aerated but batches 4-6 were kept circulating by a vertical, centrally located 104 mm diameter airlift.

Larvae collected on sieves during water changes were counted using a Sedgwick-Rafter counting cell, measured and inspected using a Wild M40 inverted compound microscope.

When eyed larvae were noticed in cultures, groups of 5-10 flat scallop valves *(Pecten meridionalis)* separated by 0.5-1 cm glass spacers were suspended in the cultures and examined daily for spat. Shells with spat were removed and suspended in a re-cycling system with a 195 l reservior and 250 l tray. Filtered water in this system was changed twice a week when 4 l of *T. suecica* was added as food.

Spat were reared for four weeks in the system and then suspended with shells spaced 30 cm apart on ropes beneath a raft in the sea at Margate.

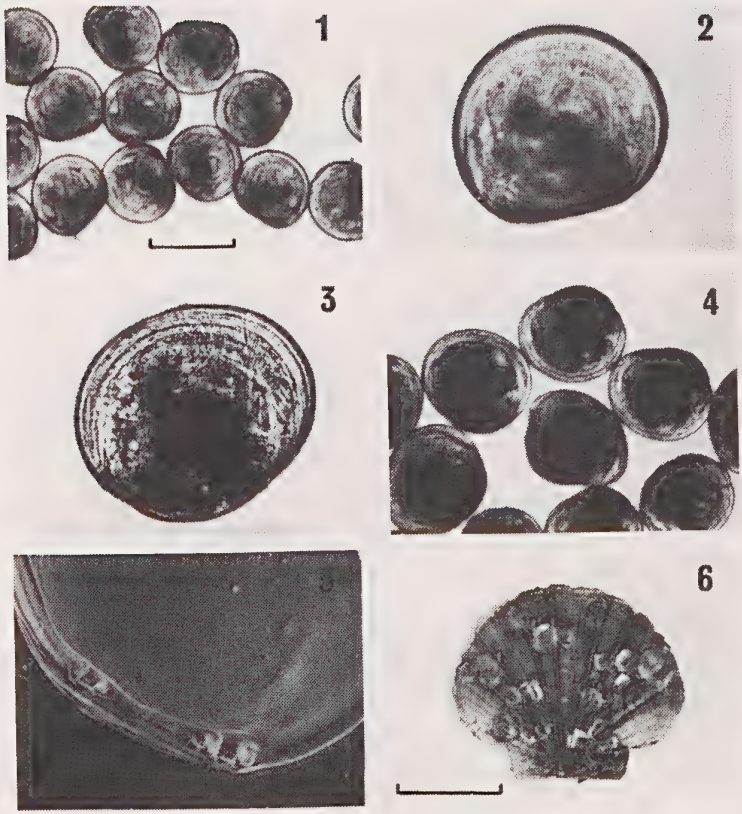
Selected larvae at various stages of development were photographed using a camera attachment to the M40 microscope and the provinicular structures of a sample of mature larvae were examined using a Jeol JXA-50A scanning electron microscope.

Descriptive terminology in this paper follows largely that of Loosanoff *et al.* (1966) and also Chanley and Andrews (1971).

RESULTS

Up to 16% of the collected adult *Ostrea angasi* samples examined during January and February were incubating larvae. None were found subsequently in 200 oysters examined from similar areas in mid-April 1975.

Incubating oysters yielded from 30 000 to 1 520 000 larvae per adult. Oysters swarmed larvae within five days of collection and the mean lengths and range of lengths of newly liberated larvae from three adults were: 192.0 μm (186-199 μm); 194.6 (190-203), and 204.2 (192-211). Larvae cultured after removal from "black-sick" oysters were similar in size: 203.9 μm (192-212 μm) and 198.3 (190-205).



FIGURES 1-6.

1. Newly swarmed *Ostrea angasi* larvae. Scale line 200 μm.
2. Individual newly swarmed larvae showing characteristic dark pigmentation. Larval size 190 172 μm.
3. More advanced larva showing rounded umbone and dark pigmentation. Larval size 250 x 230 μm
4. Group of advanced larval *Ostrea angasi*. Central larva 290 μm long.
5. Scanning electron micrograph showing the provincular structure of a 15 day old *Ostrea angas* A pair of conspicuous teeth are evident at each end of the hinge x 470.
6. *Ostrea angasi* spat attached to a scallop shell *(Pecten meridionalis)*. Spat were derived from culture started on 8 January 1975. They were transferred to the sea on 23 March an photographed in mid August 1975.

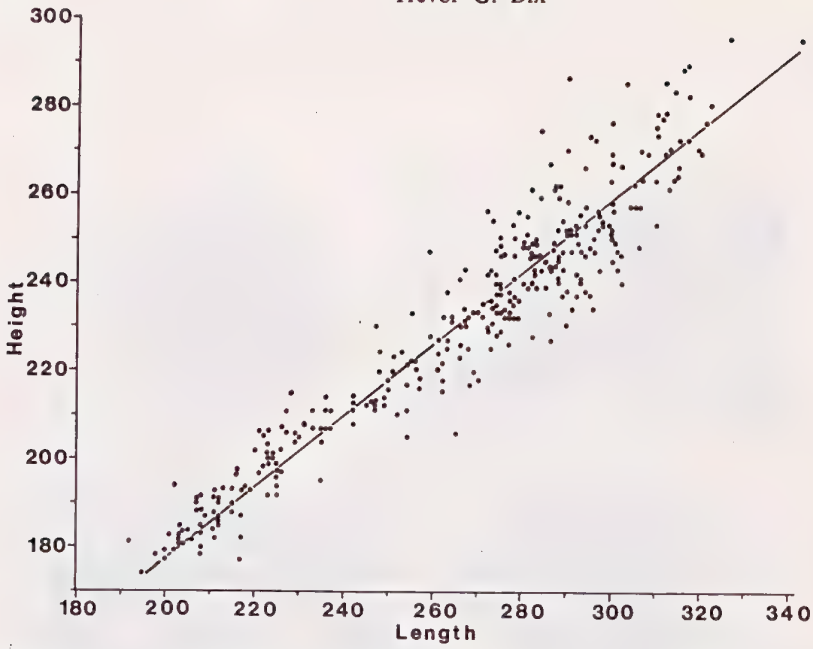


FIGURE 7.
Relationship between shell height and length for larval *Ostrea angasi*. Points represent individual paired measurements and the line the G.M. regression.

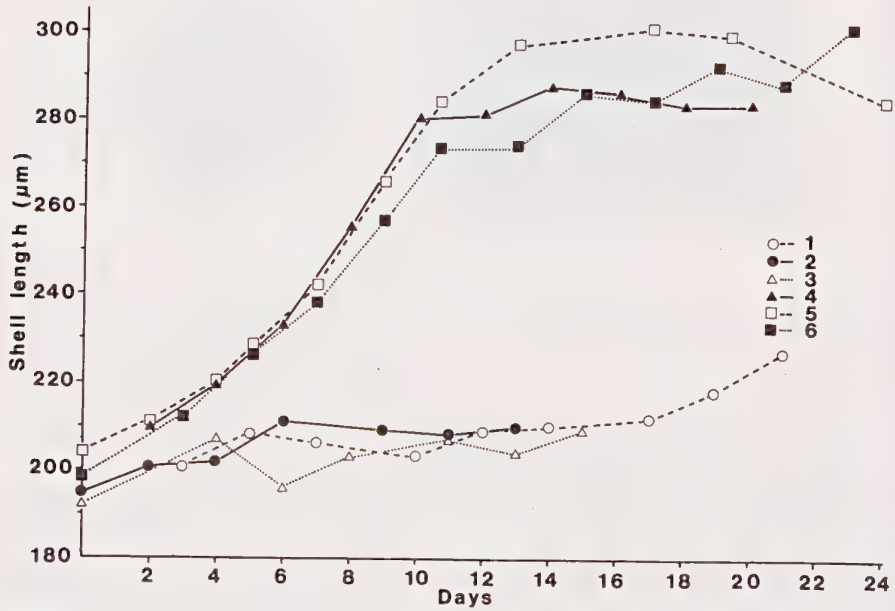


FIGURE 8.
Mean shell lengths of *Ostrea angasi* for six larval cultures (refer "methods"). Cultures were started at Day 0 and were discarded when last measurements were made.

The newly liberated larvae (Figs. 1-2) were darkly pigmented and most had indistinctly rounded umbones. Progressive growth yielded greater development of rounded umbones (Figs. 3-4) and darker pigmentation. Larvae with distinct eye-spots were evident first at a shell length of about 260 μm and common at lengths above 270 μm.

During shell growth the relationship between shell length (l) and width (w) was described adequately by a linear expression (Fig. 7). The G.M. regression for 342 paired measurements was w = 0.820 1 + 13.010 (s.e. of regression coefficient 0.014 μm and correlation coefficient 0.951).

As indicated by the maximum size of larvae in Fig. 7 most larvae had ceased swimming and had settled before reaching a shell length of 320 μm. Some reached the spat stage at 300 μm.

As described for other *Ostrea* species (Ranson, 1960; Rees, 1950), the provinicular structure of the larvae was simple with two conspicuous teeth located at each end of the hinge (Fig. 5).

Growth rates of larvae in batches 1-3 were much less than those in cultures 4-6 (Fig. 8). Larvae in the latter, circulated batches, averaged 8 μm per day length increment to a length of about 280 μm and age of 10-12 days. Smaller changes in the mean size of larvae after this time were in part related to the settlement of faster growing larvae (Batch 4) and also to a slowing of larval growth rate (Batches 5-6).

Most spat were collected in Batch 4 with numbers showing a maximum at day 14 when the mean number setting per scallop shell per day reached 33. Few settled before day 12 in this culture and setting was almost complete by day 20.

Despite the initially rapid growth rates, Batches 5 and 6 yielded few spat (maximum about 3 per day at 10 days in Batch 5 and 7 per shell per day at 25 days in Batch 6).

Although mortalities were low (< 10%) in these cultures for over 18 days, the larvae succumbed eventually before setting. Virtual extinction of the cultures occurred within several days of the appearance of ciliates in and around the larvae. This occurred also in the slow growing cultures (Batches 1-3).

One hundred and three Batch 4 spat attached to scallop shells (Fig. 6) averaged 2.11 mm length when removed from the re-cycling system and transferred to the sea on 23 March 1975. Subsequent mortality was 20.4%, and 82 oysters on the same shells had a mean length of 8.93 mm by mid-June 1975.

DISCUSSION

Systematic, seasonal sampling of adult *Ostrea angasi* was not attempted in this brief study but it appears that the main breeding season may have preceded the sampling period in view of the low percentage of larviparous oysters found in January and February and their absence in April. Interestingly, reports by W. Saville-Kent in the 1880 and early 1890's (cited by Sumner, 1972) state that the ". . . . . Tasmanian oyster spatting season lies between November and February."

Larvae raised in the present study resemble closely those of the native oyster of the Pacific coast of North America *(O. lurida)* and also the European flat oyster, *O. edulis* described by Loosanoff and Davis (1963) and Loosanoff *et al.* (1966). The shape, pigmentation, and size at setting are similar and the length/width relationships show considerable overlap.

These larvae contrast with those of the New Zealand mud oyster *O. lutaria* which is incubated to a larger size and released almost fully developed. *O. lutaria,* along with the Chilean *O. chilensis,* has a very short pelagic phase (Millar and Hollis, 1963, Hollis, 1963). Whilst Thomson (1954) considered there was insufficient evidence to separate *O. lutaria* from *O. angasi,* Hollis (1963) viewed them as a separate species. The difference now apparent between the larvae of these oysters confirms the view of Hollis.

Detailed experiments aimed at determining optimum conditions for raising larval *O. angasi* did not form part of the present study. Instead, adaptations of Walne's (1966) procedures were used. A notable adaptation concerned the use of vertical airlift in

the 90 l culture container. The airlift kept *Tetraselmis suecica* in suspension and thus available to the larvae. Whether this or other factors led to better results compared with non-circulated cultures appears to warrant further experimentation.

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